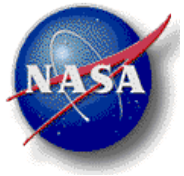


Collaboration and Knowledge Management at NASA

Patricia M. Jones, Ph.D.
NASA Ames Research Center
Patricia.M.Jones@nasa.gov

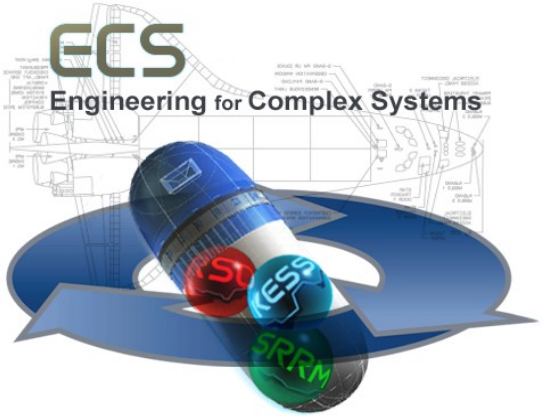
Office of Naval Research
Collaboration and Knowledge Management Workshop
January 2003

Overview

- About Me
- CKM Relevance to NASA
- Project Sampler
- How NASA works and how to get funding

My Two Roles at NASA

Human Factors
research and technology



- Deputy Division Chief, Human Factors Research and Technology, ARC
- Project Manager, “KESS” project for Risk Management for Complex Systems (RMCS) Program

CKM Relevance to NASA

- Large collaborative engineering and operations teams
  - Heterogeneous expertise
  - Geographically distributed
  - Engineering lifecycle
  - Examples: International Space Station, Shuttle, space and earth science missions, aviation operations
- Data and Information Sharing Issues
  - Heterogeneous sources and formats
  - Political and contractual considerations

CKM in the Engineering Lifecycle

Problem

Effective large-scale KM

Non-interoperable legacy systems

Disparate Data Sources

Mass Corporate Knowledge Loss

Incomplete Data Sources

Multiple Ambiguous Representations

No Formal Learning Process

Geographically dispersed workgroups

Lack of comprehensive system models

Compartmentalized Knowledge

Insufficient Infrastructure

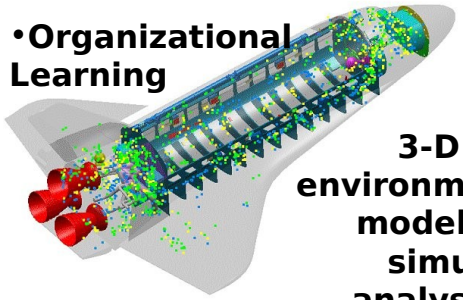
Inconsistent configuration control

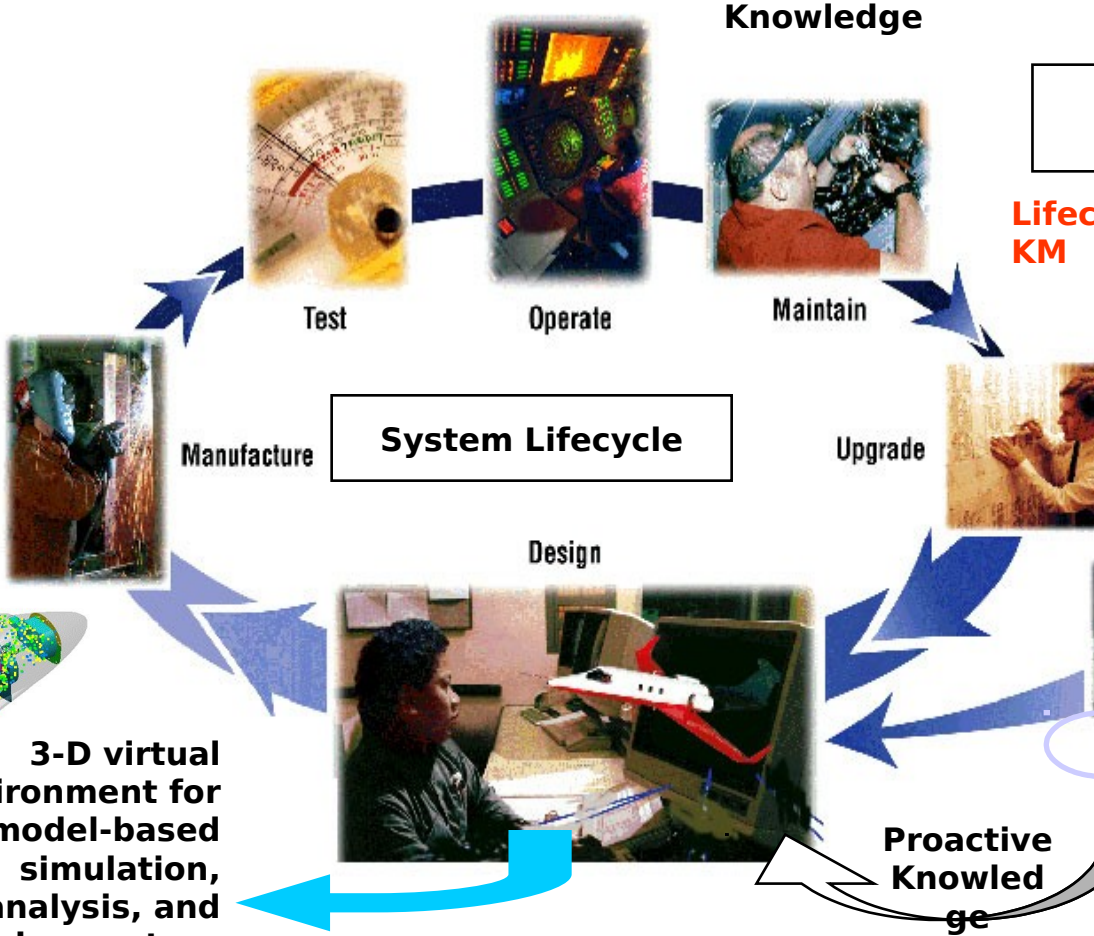
Solution

Lifecycle Integrated KM

Knowledge Modeling

- Lifecycle consistent taxonomy/ontology
- Effective reusable data models
- Unambiguous communication
- Secure Advanced Federated Environment (SAFE) enhanced network Collaboration
- **Organizational Learning**





3-D virtual environment for model-based simulation, analysis, and knowledge capture

Proactive Knowledge

Organizational Learning

Digital Libraries

Integrated Machine & Human Learning

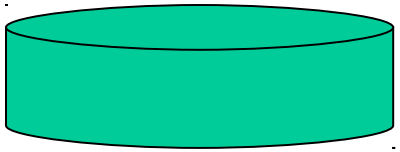
CKM at NASA: A Sampler

- **Information Analysis and Decision Support**
  - Aviation Safety Reporting System (ASRS)
  - Perilog
  - Science Desk (and IO spinoff)
  - Aviation Operations: APMS, PDARS, NAOMS
  - Knowledge Portal for Mission Control
- **Virtual Vehicles ("Virtual Iron Birds")**
  - Digital Shuttle
  - Virtual Station / SimStation
- **Collaboration Infrastructure and Tools**
  - Secure Advanced Federated Environment (SAFE)
  - DARWIN
  - Aerospace Extranet (AEN)
  - MERBoard

Aviation Safety Reporting System (ASRS)

Directline
A Review of Altimeter-Setting Incidents Reported to ASRS
4 The Low-Down on Altimeter Settings
11 Passenger-Related Safety Hazards
16 Balloon Incidents
And
ASRS Operational Issues Bulletin 96-01

CALLBACK
From NASA's Aviation Safety Reporting System



- ASRS collects, analyzes, and responds to voluntarily submitted aviation safety incident reports in order to lessen the likelihood of aviation accidents.

- Established in 1975 under a Memorandum of Agreement between the FAA and NASA
- Over 460,000 reports collected to date
- CALLBACK, the monthly newsletter, has a subscription base of over 85,000 users in the aviation community

Perilog

- Text mining tool for narratives
  - Formerly known as QUORUM
- Patents pending
- http://human-factors.arc.nasa.gov / lhpublications / McGreevy.AFO.WWW/ASRS.search/search.home.html

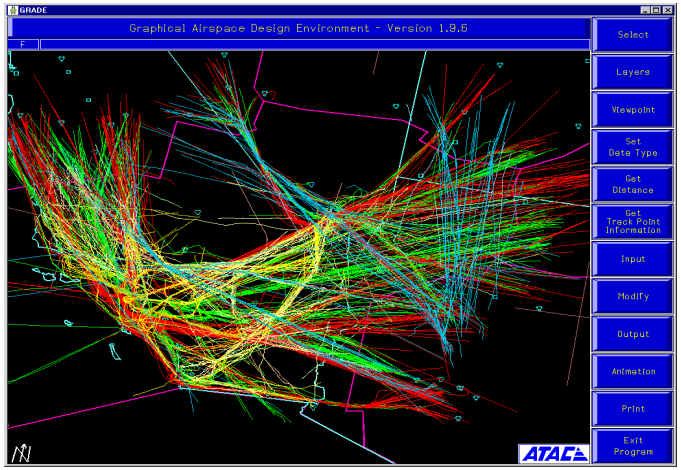
Science Desk

- Support for collaborative science teams
- Web-based multimedia repository
- Collaboratory
- Automated knowledge acquisition
- Spinoff: Investigation Organizer
- http://sciencedesk.arc.nasa.gov/scidesk/

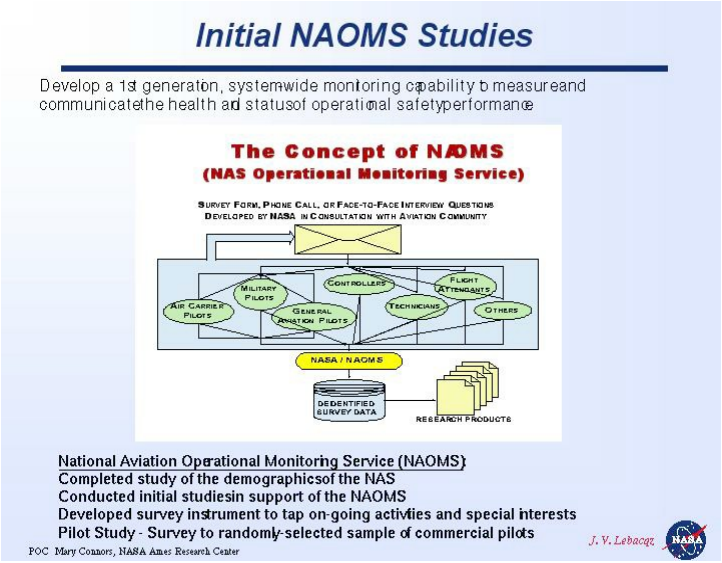
Aviation Operations: APMS

The **Aviation Performance Measuring System** is a joint NASA-FAA effort to assist flight analysts in acquiring, analyzing, and interpreting data from flight data recorders on commercial aircraft.

Aviation Operations: PDARS and NAOMS



PDARS: Joint NASA-FAA project on air traffic control visualization and analysis tools

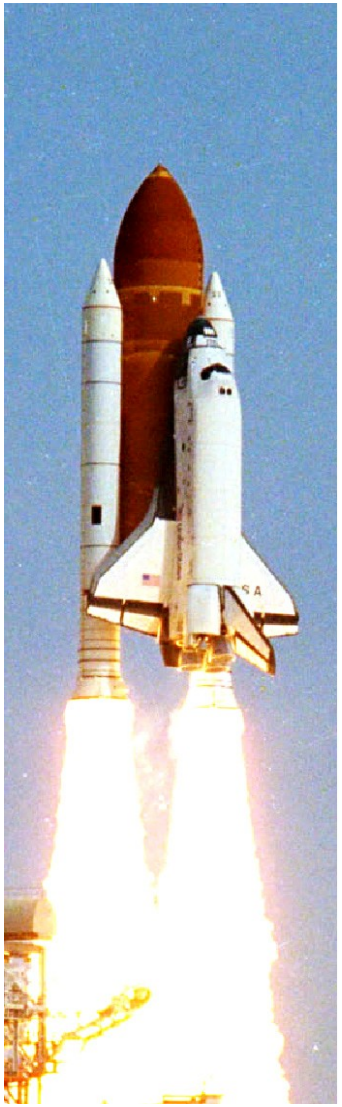

Initial NAOMS Studies
Develop a 1st generation, system-wide monitoring capability to measure and communicate the health and status of operational safety performance
The Concept of NAOMS
(NAS Operational Monitoring Service)
Survey Form, Phone Call, or Face-to-Face Interview Questions Developed by NASA in Consultation with Aviation Community
Controllers
Flight Attendants
Military Pilots
Air Carrier Pilots
General Aviation Pilots
Technicians
Others
NASA / NAOMS
De-identified Survey Data
Research Products
National Aviation Operational Monitoring Service (NAOMS)
Completed study of the demographics of the NAS
Conducted initial studies in support of the NAOMS
Developed survey instrument to tap on-going activities and special interests
Pilot Study - Survey to randomly-selected sample of commercial pilots
POC Mary Connors, NASA Ames Research Center
J. V. Lebacqz

National Aviation Operations Monitoring System (NAOMS)
The first comprehensive, statistically defensible survey approach to collecting aviation event rates.

Knowledge Portal for Mission Control

- Web-based portal for access to useful tools for flight controllers
- Shift logs, handover logs, anomaly reports...

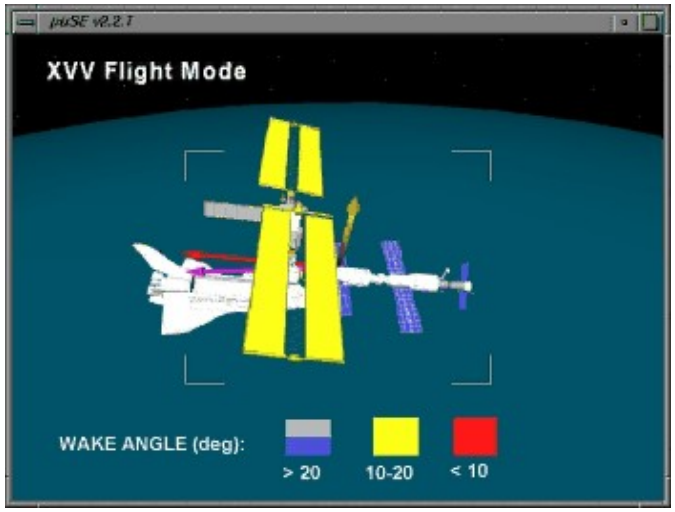
Digital Shuttle

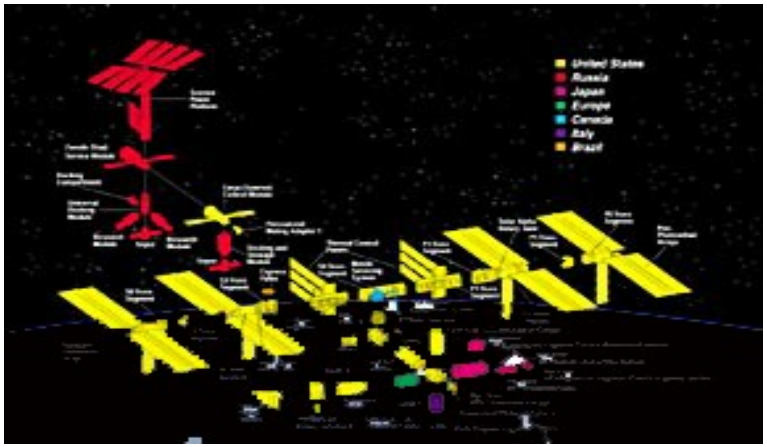


- Goals
  - Facilitate management and engineering processes
  - Cope with corporate knowledge loss
  - Focus: Drawings, aging wiring, PRACA
- Sample Activities
  - Shuttle ontology development
  - PDM / ERP
  - Convert 2-D drawings of Space Shuttle Orbiter to 3-D CAD models

Virtual Station / SimStation

Attitude control simulation
Product of ISE Program, NASA LaRC

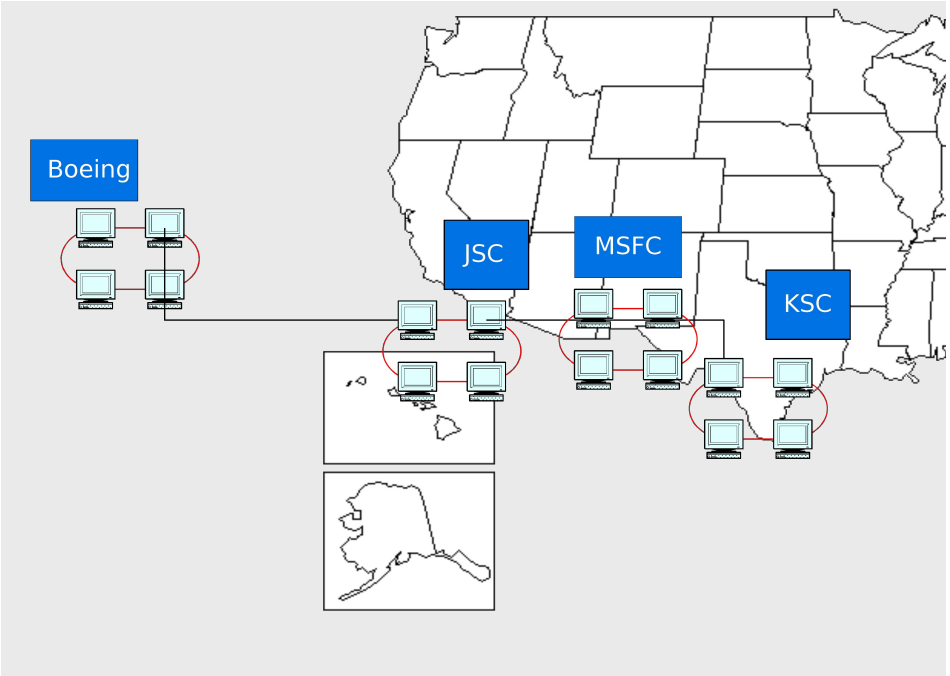




- Model-based visualization and simulation of ISS
- Geometric, behavioral, connectivity models
- Variety of customers: Astronauts, training, systems engineering teams, msn control

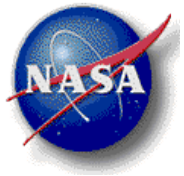
SAFE: Secure Advanced Federated Environment

- Geographically distributed workgroups, processes, IT systems, tools
- Contractual barriers to effective Enterprise-wide KM
  - NASA
  - United Space Alliance
  - Boeing
  - Lockheed-Martin
  - Others…



SAFE = Secure Advanced Federated Environment
DFS = Distributed File System

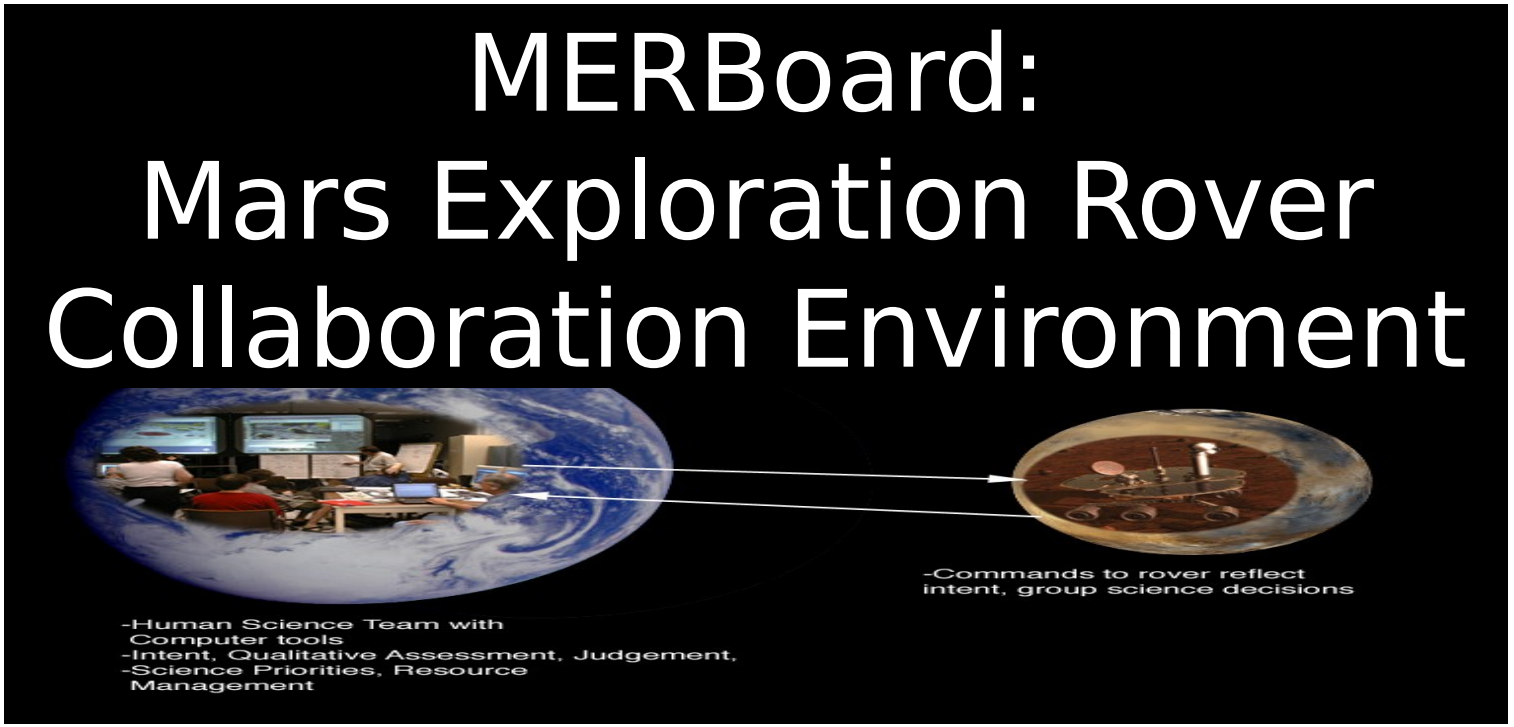
Secure, Distributed Access to SSP data, systems, and, tools on the SAFE / DFS network



Aerospace Extra Net (AEN)

- Networking, database, and intelligent agent support for aviation applications
  - Netmark: Storage
  - Remote Aviation Help Desk
  - Simulation Information Sharing (baseline risk exposure)
  - Remote Tower Sensor System
  - Knowledge Agent-Oriented System (KAoS)
- http://ic.arc.nasa.gov/projects/aen/

MERBoard: Mars Exploration Rover Collaboration Environment


-Human Science Team with Computer tools
-Intent, Qualitative Assessment, Judgement,
-Science Priorities, Resource Management
-Commands to rover reflect intent, group science decisions

- 50” plasma display with touchscreen
- 4 core applications
  1. Browser / data display tools
  2. Virtual network computer for real-time sharing/control
  3. Digital whiteboard with drawing tools (including MER specific tools for Long Term Planning)
  4. Pervasive and ubiquitous data storage and retrieval
- meta-tools for data capture and distribution

Design Knowledge Capture

- Ongoing interest of joint Ames-JPL team
- Ethnographic study of design teams
- Methods for capturing and analyzing knowledge

How to Connect with NASA

- Get to know the researchers
- Possible: Unsolicited Proposals
  - http://ec.msfc.nasa.gov/hq/library/unSol-Prop.html
- Better: Competitive Opportunities
  - NASA Research Announcements (NRAs) and SBIRS
    - http://research.hq.nasa.gov/research.cfm
- Better Yet: NASA and ONR should work more closely together!